



*Advanced Research Systems, Inc.*

## **MODEL ARS-830 HELIUM COMPRESSOR**

### **TECHNICAL MANUAL**

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## SPECIAL NOTICES

Three types of special notices – warnings, cautions, and notes – are used in the chapters of the refrigeration system manuals. They appear as follows and serve the purposes stated.



**WARNINGS CALL ATTENTION TO ACTIONS OR CONDITIONS WHICH CAN RESULT INJURY TO PERSONNEL.**

### CAUTION

**CAUTIONS CALL ATTENTION TO ACTIONS OR CONDITIONS WHICH CAN RESULT IN DAMAGE TO THE EQUIPMENT OR IN ABNORMAL PERFORMANCE.**

### NOTE

Notes give important, additional items of information related to but not truly a part of the procedure or discussion presented.

Warnings and cautions, like safety instructions, appear in the text where they are especially applicable. Because of their importance, they are summarized in the Safety section – the first section to be read.

## SAFETY

### WARNING

HIGH VOLTAGE is present within the system and can cause severe injury from electrical shock. Permit only qualified electrical technicians to open any electrical enclosure to perform electrical troubleshooting.

### WARNING

HIGH GAS PRESSURE is present within the system and can cause severe injury from propelled particles or parts. Vent the compressor before removing or opening any parts, except when disconnecting the Aeroquip Self-Sealing Gas Couplings.

### WARNING

DO NOT RECHARGE the system without using a pressure regulator.

### WARNING

Always disconnect the cryocooler from all sources of electrical power before performing any maintenance or troubleshooting procedures.

### WARNING

Depressurize the adsorber before disposing of it. Attach the depressurization fitting (included in the Installation Tool Kit) to the coupling half at either end of the adsorber and tighten it slowly.

### WARNING

The compressor motor is hot after operating. Wait for the motor to cool down before working on the inside of the compressor.

## 2. COMPRESSOR SPECIFICATIONS

### Dimensions

Length	18.0 inches (457 mm)
Width	18.0 inches (457 mm)
Height	21.5 inches (546 mm)

### Weight

150 lb (68 kg)

### Power Requirements

<u>MODEL</u>	<u>VAC ± 5%</u>	<u>HZ</u>	<u>PHASE</u>	<u>AMPS</u>
ARS-830 Water Cooled	208/230	60	1	17

### Helium Pressure

Static:	210 ± 5 psig (1448 ± 34 kPa)
Operating:	Supply: 280 ± 10 psig (1931 ± 69 kPa)
	Return: 50 ± 10 psig (345 ± 69 kPa)

### Interfaces

- Cold Head Power Connector or Cable: Mates with DE-202/DE-204 interconnect power cable (standard 11 ft length).
- Compressor Input Power: Standard 10 ft long power cord, 12/3, 300 V equipped with Hubbell No. 2321 plug (NEMA L6-20P)
- Helium Connections: #8 Aeroquip male self-sealing gas couplings. Standard 10 ft long x ½ in i.d. flexible SS gas lines, with #8 Aeroquip female self-sealing gas couplings both ends, provided.

### Adsorber Replacement Schedule

12,000 operating hours (per elapsed time meter)

### Cooling Water

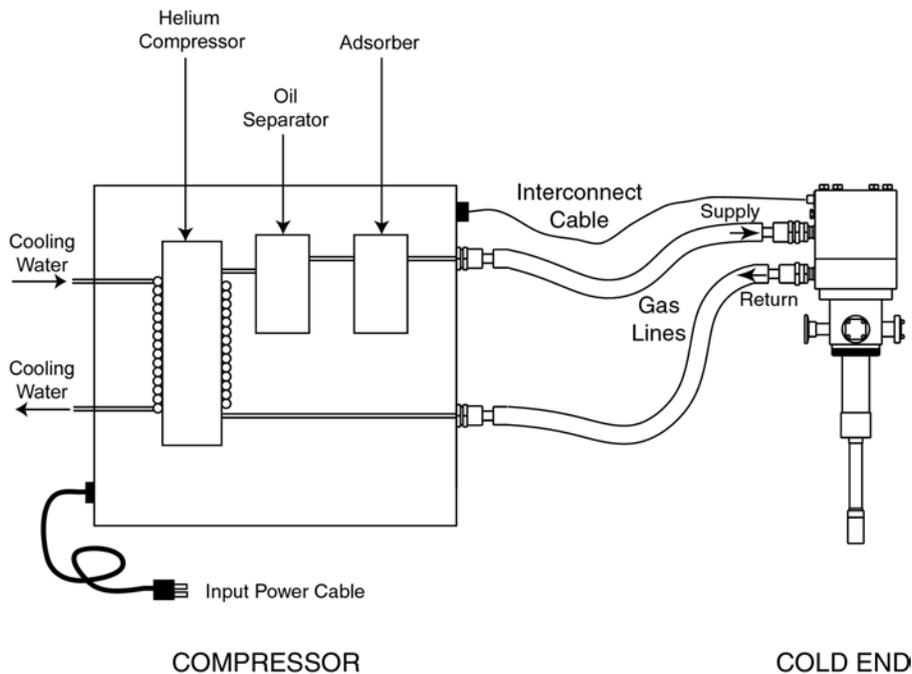
0.8 gal/min (3 L/min), 80 F (27 C) Maximum Inlet Temperature

### Ambient

45-100 F (7-37 C)

## 2. COMPRESSOR INSTALLATION

1. Connect the power cable to a suitable connector or disconnect box making sure that the compressor on-off switch is off. Only qualified electrical service personnel that are familiar with all national, state and local codes should perform this work.
3. Cooling Water
  - a. Typical municipal drinking water is recommended.
  - b. 0.8 gal/min (3 L/min) is required to achieve a maximum discharge temperature of 100 F (38 C); with 80 F (27 C) considered ideal.
3. Verify that helium pressure is  $210 \pm 5$  psig ( $1448 \pm 34$  kPa). If pressure is low, refer to page 8, steps 3-6 for charging procedure.
4. With the cover in place and cooling water on, start the compressor and run for 15 minutes to stabilize the compressor oil inventory.
5. The compressor is now ready to be connected to the cold end. See Figure 2.1.

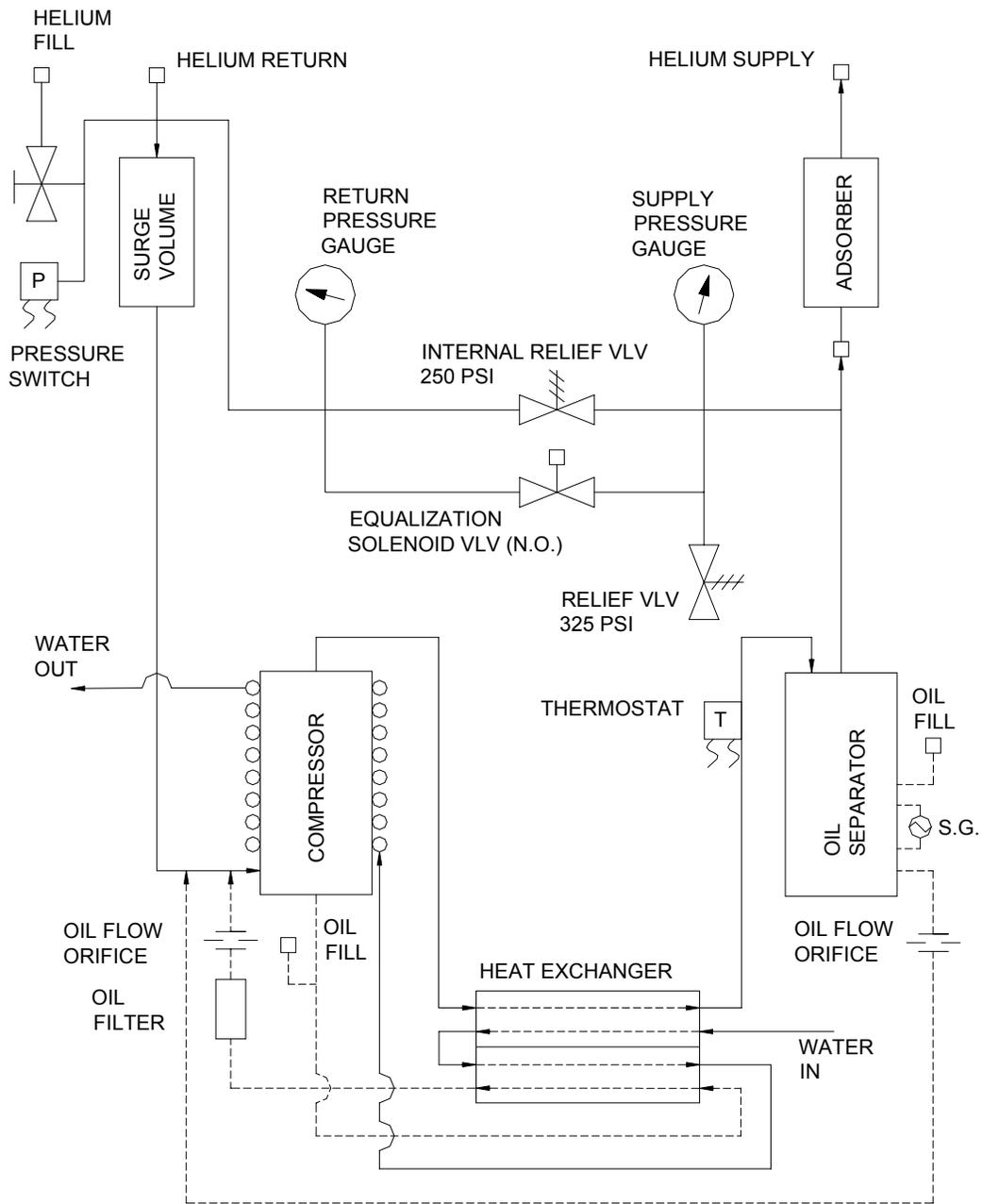


**Figure 2.1** Compressor / Cold End Connections

### **3. COMPRESSOR OPERATION**

## Flow Diagram





**Figure 3.1** Flow Diagram for Model ARS-830 Water Cooled

## 4. MAINTENANCE PROCEDURES

### **⚠ WARNING**

Always disconnect the cryocooler from all sources of electrical power before performing any maintenance procedures.

### 4.1 Scheduled Maintenance

The only scheduled maintenance required on the Model ARS-830 Compressor is replacement of the compressor adsorber after every 12,000 hours of operation as indicated on the compressor elapsed time meter. To remove and replace the compressor adsorber proceed as follows:

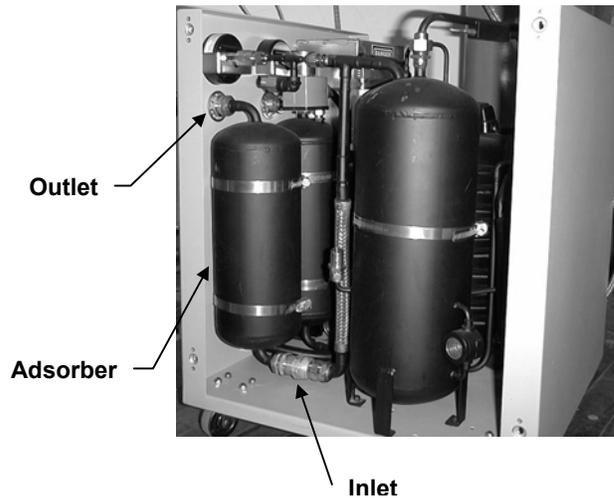
1. Turn off the compressor.
2. Disconnect the supply gas line at the compressor. Use the two wrenches supplied in the Installation and Maintenance Tool Kit to avoid loosening the gas line coupling (female) from its adapter. Hold the 1 inch wrench fast on the coupling half attached to the adapter. Use the other wrench (1 3/16 inch) to loosen the gas line coupling (female) from the helium supply coupling (male) on the compressor.
3. Remove the compressor cover (8 ¼-turn screws).
4. Remove the adsorber from the compressor by: 1) disconnecting the inlet coupling; 2) removing the jam nut from the outlet (male helium supply coupling) on the front of the compressor; and, 3) loosening the 2 metal straps. See Figure 4.1. Save the jam nut and metal straps.

### **⚠ WARNING**

Depressurize the adsorber before disposing of it. Attach the depressurization fitting (included in the Installation Tool Kit) to the coupling half at either end of the adsorber and tighten it slowly.

5. Install the replacement adsorber as follows:
  - a. Remove the dust caps from the self-sealing gas couplings at each end of the replacement adsorber.
  - b. Check the gasket seal ring (flat rubber gasket) on each male self-sealing gas coupling to make sure that it is clean and properly positioned. See Figure 4.2.
  - c. Install the replacement adsorber per Figure 4.1, in reverse order. Use the jam nut and metal straps saved in step 4.

- d. Make the inlet connection quickly to minimize gas leakage. Make the first turns by hand and then firmly seal the connection using the two wrenches, supplied in the Installation and Maintenance Tool Kit, until the fittings “bottom”. Refer to Figure 4.2 for proper coupling of the self-sealing gas connection.



**Figure 4.1 Adsorber Replacement**

6. Replace the compressor cover. Re-attach the helium supply gas line.
7. Insure that the supply pressure gauge reads  $210 \pm 5$  psig ( $1448 \pm 34$  kPa). If additional gas pressure is required, follow the instructions in Section 4.2, Adding Helium Gas.
8. Add 12,000 to the reading on the elapsed time meter and write this total on a label as a reminder. The label should be affixed to the front of the compressor.

## 4.2 Unscheduled Maintenance

### Adding Helium Gas

**CAUTION !**

If the compressor helium pressure gauge reads 0, decontamination is required, refer to Gas Cleanup Procedure, Section 4.4.

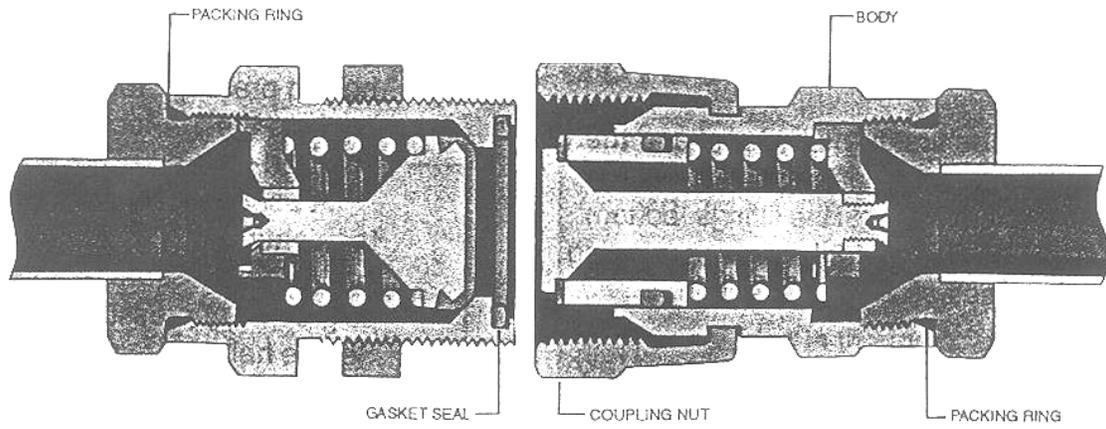
If you need to add helium more than once every several months, check for leaks caused by improperly connected self-sealing gas couplings or incorrectly seated charge valves.

Use only 99.999% ultra-pure helium gas with a dew point less than  $-50\text{ C}$  ( $-58\text{ F}$ ) at 300 psig (2069 kPa).

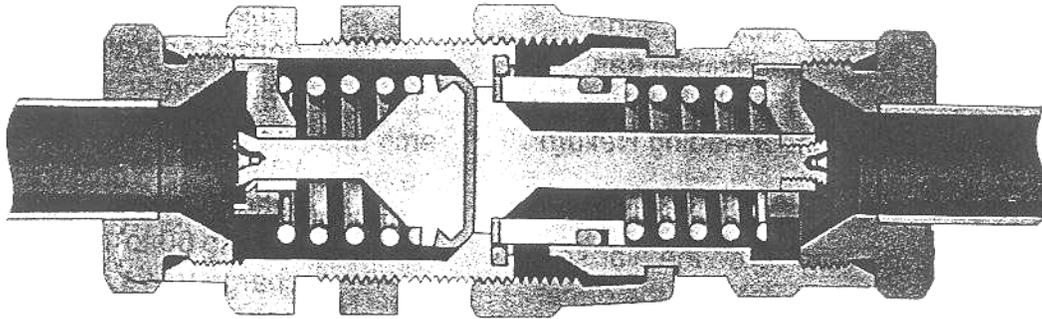
To add helium gas:

1. A user-supplied clean dry metal charging line and a clean helium pressure regulator rated at 400 psig (2758 kPa) delivery pressure are required. Attach the charging line from the pressure regulator on a helium cylinder to the smaller #4 Aeroquip male self-sealing fitting on the front of the compressor below the service valve using the female adapter coupling in the Installation and Maintenance Tool Kit.
2. Loosely connect the female adapter coupling to the charging line. Set the helium pressure regulator to 10 to 25 psig (69-172 kPa). Allow helium gas to purge the charging line and adapter coupling for 30 seconds to purge them of air. Then, while still purging, tighten the adapter coupling to the end of the charge line and onto the male service fitting.
  - a. If the compressor is running under normal operating conditions, set the helium pressure regulator to 300 psig (2069 kPa) and slowly open the helium service valve on the front of the compressor. When the helium supply pressure gauge on the compressor rises to 250-260 psig (1724-1793 kPa), tightly close the service valve.
  - b. If the compressor is not running, set the helium pressure regulator to 250 psig (1724 kPa) and slowly open the helium service valve. When the helium supply and return pressure gauges on the compressor rise to  $210 \pm 5$  psig ( $1448 \pm 34$  kPa), tightly close the service valve.
3. Ensure that the helium service valve on the compressor is tightly closed. Then shut off the helium pressure regulator on the helium cylinder. Remove the charging line from the service fitting and reinstall the dust cap.

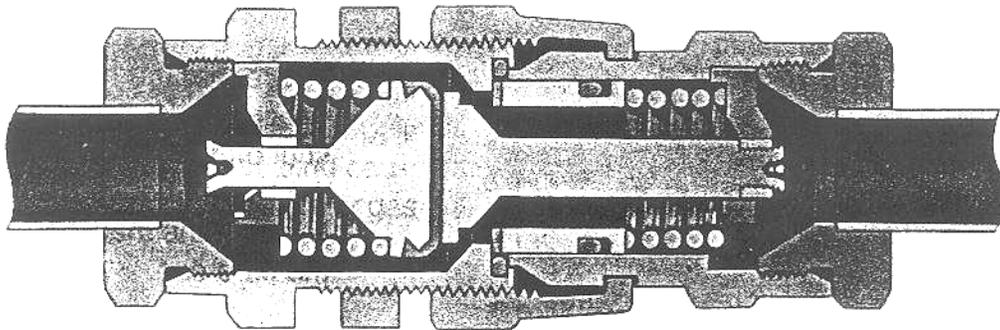
### 4.3 Aeroquip Self-Sealing Gas Couplings



**Coupling Halves Disconnected**



**Coupling Halves Partially Connected**



**Coupling Halves Fully Connected**

**Figure 4.2** Cross Sectional View of Aeroquip Self-Sealing Gas Couplings

## 4.4 Gas Cleanup

Gas cleanup is required if the compressor's interior has been opened to the atmosphere or the equalization pressure is 20 psig (138 kPa) or lower. Gas cleanup is performed with the compressor disconnected from the cold end.

### NOTE

If the compressor's interior has been exposed to the atmosphere for an extended period, gas cleanup may not suffice to guarantee system gas purity. Adsorber replacement will also be required.

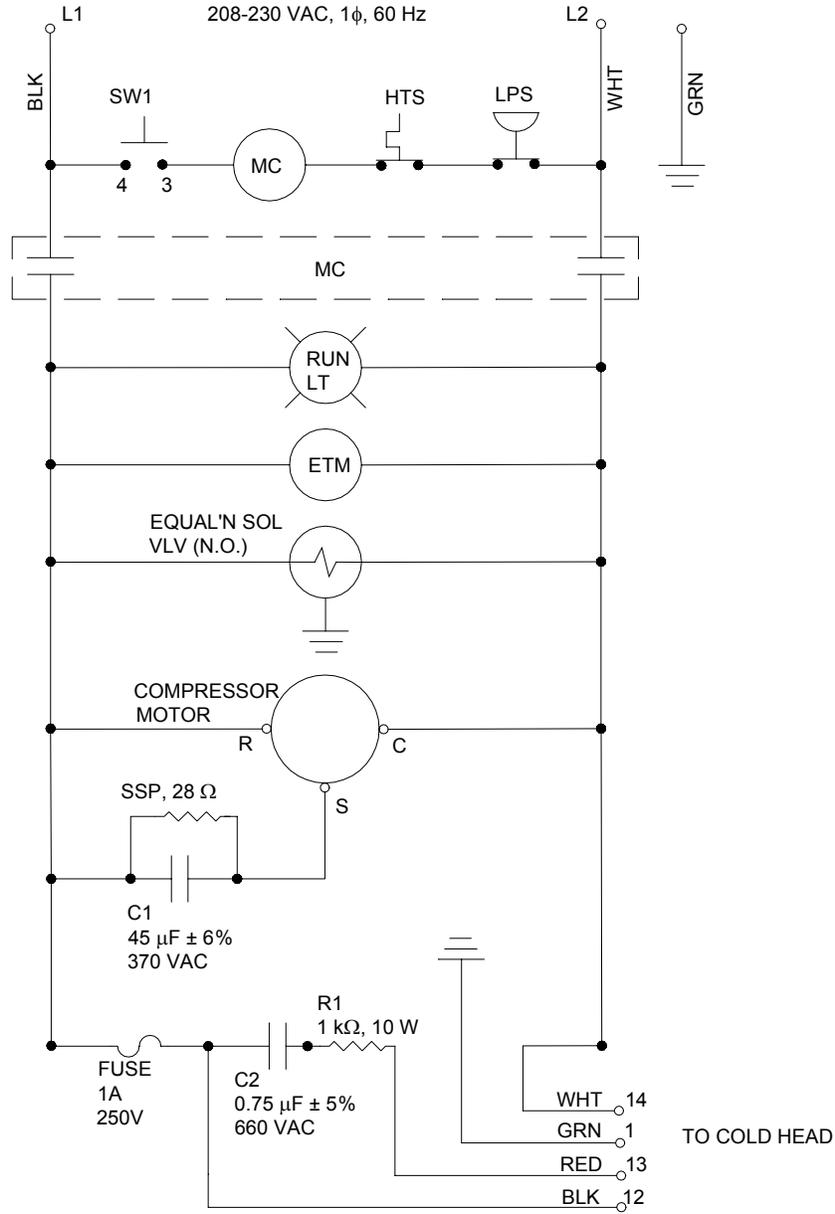
Use only 99.999% ultra-pure helium gas with a dew point less than  $-50\text{ C}$  ( $-58\text{ F}$ ) at 300 psig (2069 kPa).

1. Disconnect the gas lines from the compressor. Screw dust plugs into the disconnected gas line couplings.
2. Locate an adapter fitting, P/N 001075, in the Installation and Maintenance Tool Kit. Be sure the valve is closed. Attach it to the helium supply (outlet) coupling on the front of the compressor.
3. Perform steps 1 and 2 in section 4.2, Adding Helium Gas. Ignore steps 2.a. and 2.b.
5. Adjust the pressure regulator to 210 psig (1448 kPa). Open the service valve and charge the compressor to 210 psig (1448 kPa). Close the service valve.
6. Run the compressor for at least 30 minutes to heat the oil to operating temperature. Stop the compressor.
7. Adjust the pressure regulator to 100 psig (690 kPa).
8. Open the vent valve (the adapter fitting) on the supply coupling of the compressor. Watch the compressor's pressure gauge. When the pressure falls to  $< 10\text{ psig}$  ( $< 69\text{ kPa}$ ), close the vent valve.
9. Open the service valve and charge the compressor to 100 psig (690 kPa). Close the service valve.
10. Repeat Steps 8 and 9 five (5) times.
11. Adjust the pressure regulator to 210 psig (1448 kPa).
12. Open the service valve and charge the compressor to 210 psig (1448 kPa). Close the service valve.

13. Run the compressor for 30 seconds. Stop the compressor.
14. Open the vent valve (the adapter fitting) on the supply coupling of the compressor. Watch the compressor's pressure gauge. When the pressure falls to < 10 psig (< 69 kPa), close the vent valve.
15. Repeat Steps 12, 13, and 14 five (5) times.
16. Open the service valve and charge the compressor to 210 psig (1448 kPa). Close the service valve.
17. Allow the compressor to cool. Read the pressure gauge with the compressor at room temperature 20-24 C (68-76 F). Adjust the equalization pressure by charging or venting to conform to the specification of  $210 \pm 5$  psig ( $1448 \pm 34$  kPa).
18. Ensure that the helium service valve on the compressor is tightly closed. Then shut off the helium pressure regulator on the helium cylinder. Remove the charging line from the service fitting and reinstall the dust cap. Store the charging line with the adapter coupling attached and filled with helium gas to keep it internally clean and dry.
19. Remove the vent adapter fitting from the compressor helium supply gas coupling.
20. If other components (gas lines, cold end) need a gas cleanup, refer to the procedures in their technical manual. Otherwise, reconnect the supply and return gas lines to the compressor.

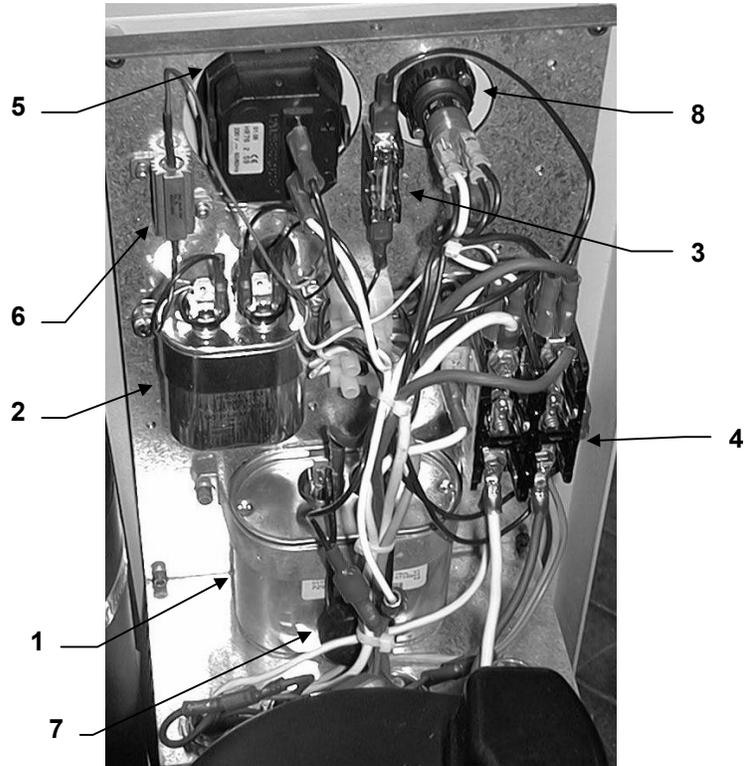
## 5. ELECTRICAL COMPONENTS

### Electrical Schematic



**Figure 5.1** Electrical Schematic for Model ARS-830 Water Cooled

## Electrical Component Location



Item	Description	Ref. Desig.
1	Capacitor, Run, 45 $\mu\text{F} \pm 6\%$ 370 VAC	C1
2	Capacitor, Cold Head, 0.75 $\mu\text{F} \pm 6\%$ 370 VAC	C2
3	Fuse, 1 A, 250 VAC	FUSE
4	Motor Contactor	MC
5	Meter, Elapsed Time	ETM
6	Resistor, Cold Head, 1 k $\Omega$ , min. 10 W	R1
7	Bleed Resistor, 28 $\Omega$	SSP
8	Switch, Compressor "On-Off" w/ Run Light	SW1

**Figure 5.2** Electrical Control Chassis, ARS-830 Water Cooled

## 6. COMPRESSOR TROUBLESHOOTING



Disconnect the compressor from its power source before performing any troubleshooting procedures.



The compressor motor is hot after operating. Wait for the motor to cool down before working on the inside of the compressor.

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
1. The compressor ON/OFF switch (SW1) remains in the ON position when switched on but the motor does not run.	1.1. No electrical power.	1.1. Check power source, power cord, service fuses, circuit breakers and wiring associated with power source.
	1.2. Incorrect or disconnected wiring within the compressor.	1.2. Check wiring per electrical schematic, Figure 5.1.
	1.3. Defective motor contactor (MC).	1.3. Check relay coil resistance. Check for open circuit.
2. Compressor stops shortly after starting and remains off.	2.1. High temperature of the compressor or supply gas is caused by insufficient cooling water, resulting in the opening of high temperature switch (HTS).	2.1. Confirm that sufficient cooling water is flowing to the compressor. Check for proper cooling conditions per Section 1.
	2.2. Very cold cooling water was left running through the compressor.	2.2. Turn on the compressor and let it run until it has stopped. Do this several times allowing the oil temperature to rise and the compressor to operate continuously.
	2.3. Low helium pressure as indicated by the pressure gauges, resulting in the opening of the low pressure switch (LPS).	2.3. Add helium per section 4.2.
	2.4. Low power source voltage.	2.4. Confirm power source voltage is correct.

<b>PROBLEM</b>	<b>POSSIBLE CAUSE</b>	<b>CORRECTIVE ACTION</b>
2. Compressor stops shortly after starting and remains off (continued).	2.5. Failed motor or locked rotor.	2.5. Check for high current draw. Contact the Service Department.
	2.6. Compressor internal motor overload relay open.	2.6. Check motor winding resistances. Check for open circuit.
3. Compressor runs but pressures are abnormally high or low.	3.1. Incorrect equalization pressure.	3.1. Add helium per section 4.2.
	3.2. Equalization solenoid valve failed open, resulting in high operating return pressure and low operating supply pressure.	3.2. Either the coil has failed or the internal valve is stuck. Turn the compressor off. Electrically disconnect the solenoid coil from the rest of the circuit (see electrical schematic, Figure 5.1). Check the coil for continuity. If continuity does exist, then the coil is good and the internal valve is stuck open. Contact the Service Department.
	3.3. Gas line couplings are not fully engaged.	3.3. Check that all couplings are tight. See Figure 4.2.
	3.4. Gas lines are connected wrong.	3.4. Check gas lines connect supply (red) and return (green) correctly. See Figure 2.1.
	3.5. Gradual loss of gas due to leakage	3.5. Check for leaks. Add helium per section 4.2.

## 7. CONTACT INFORMATION

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